Robert C. Colwell, Reg. No. 27,431   (650) 326-2400

Applicant: Yoichi Mizuno, *et al.*
Title: Disk Array System Capable for Taking Over Volumes Between...
Atty Docket No. 16869S-043800
Sheet 1 of 10

W 0090

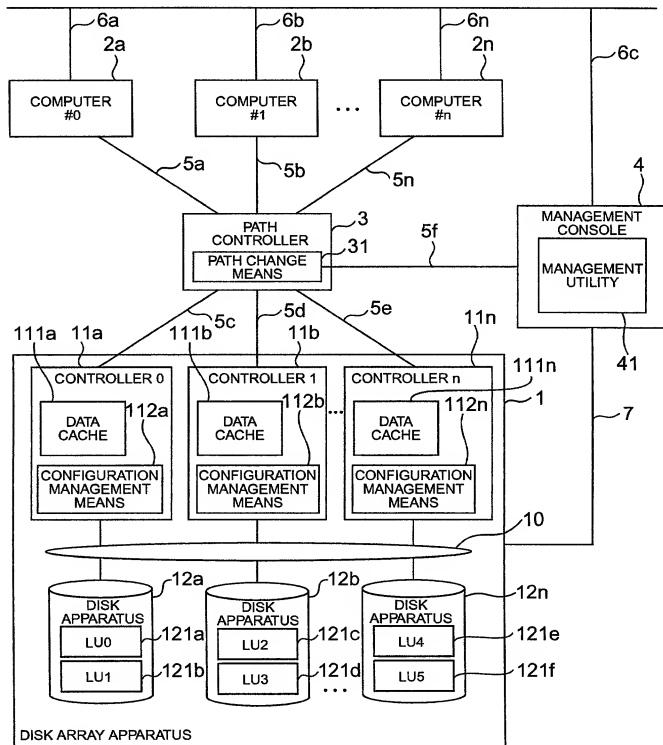# FIG. 1

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Title: Disk Array System Capable for Taking Over Volumes Between...

Atty Docket No. 16869S-043800

Sheet 2 of 10

FIG. 2

CONFIGURATION INFORMATION TABLE

1121

INTERNAL LUN	EXTERNAL LUN	PORT NUMBER	CONTROLLER NUMBER		BLOCK NUMBER	RAID GROUP NUMBER	RAID LEVEL	PHYSICAL ADDRESS INFORMATION
			DEFAULT	CURRENT				
...	...	...	...	...	...	...	...	...

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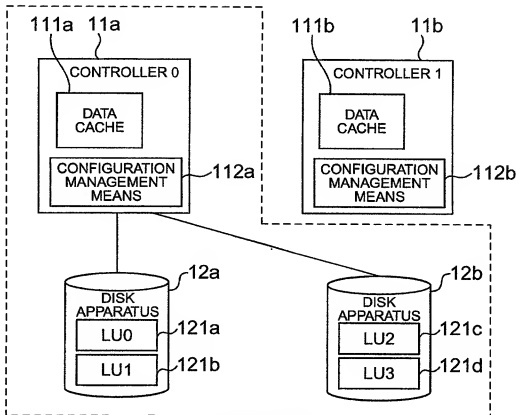
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Atty Docket No. 16869S-043800

Sheet 3 of 10

FIG. 3

```
        ┌─────────────────────┐
        │        START        │─── 800
        │    LU TAKE-OVER      │
        └─────────────────────┘
                   │
     ┌──────────────────────────────┐
     │   OPERATOR DESIGNATES LU      │
     │     TO BE TAKEN OVER AND      │─── 801
     │  SWITCH-DESTINATION CONTROLLER│
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │  MANAGEMENT UTILITY 41 SENDS  │
     │    LU TAKE-OVER INSTRUCTION   │─── 802
     │    TO DISK ARRAY APPARATUS 1  │
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │  CONFIGURATION MANAGEMENT     │
     │       MEANS 112 MIGRATES      │─── 803
     │ CONFIGURATION INFORMATION OF LU│
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │        DE-STAGE DATA OF       │─── 804
     │  SUBJECT LU ON DATA CACHE 111 │
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │ AFTER COMPLETION OF DE-STAGE, │
     │     INSTRUCT PATH CHANGE      │─── 805
     │   MEANS 31 OF SWITCH PATH     │
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │    TEMPORARILY SUSPEND        │─── 806
     │    ACCESS TO SUBJECT LU       │
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │     PATH CHANGE MEANS 31      │─── 807
     │    PERFORMS PATH SWITCH       │
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │  SWITCH CONTROL OF SUBJECT    │
     │   LU TO SWITCH-DESTINATION    │─── 808
     │         CONTROLLER            │
     └──────────────────────────────┘
                   │
     ┌──────────────────────────────┐
     │  RESUME ACCESS TO SUBJECT LU  │─── 809
     └──────────────────────────────┘
                   │
        ┌─────────────────────┐
        │       END OF        │─── 810
        │    LU TAKE-OVER     │
        └─────────────────────┘
```

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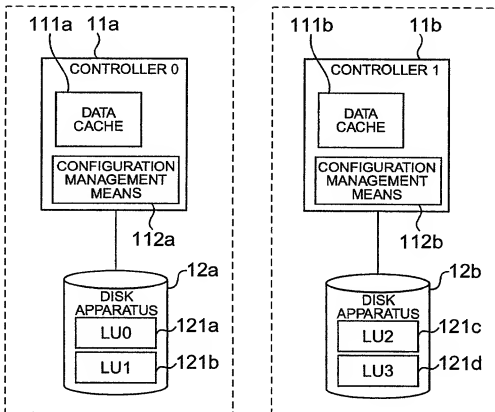
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Atty Docket No. 16869S-043800

Sheet 4 of 10

FIG. 4A

```
111a  11a                              111b        11b

  ┌─────────────────────┐      ┌─────────────────────┐
  │   CONTROLLER 0       │      │   CONTROLLER 1      │
  │                      │      │                     │
  │   ┌──────────┐       │      │   ┌──────────┐      │
  │   │  DATA    │       │      │   │  DATA    │      │
  │   │  CACHE   │       │      │   │  CACHE   │      │
  │   └──────────┘       │      │   └──────────┘      │
  │  ┌─────────────┐     │      │  ┌─────────────┐    │
  │  │CONFIGURATION│─112a│      │  │CONFIGURATION│─112b│
  │  │ MANAGEMENT  │     │      │  │ MANAGEMENT  │     │
  │  │   MEANS     │     │      │  │   MEANS     │     │
  │  └─────────────┘     │      │  └─────────────┘    │
  └─────────────────────┘      └─────────────────────┘

         ┌──────12a                      ┌──────12b
      ┌─────────┐                     ┌─────────┐
      │  DISK   │                     │  DISK   │
      │APPARATUS│                     │APPARATUS│
      │ ┌─────┐ │─121a                │ ┌─────┐ │─121c
      │ │ LU0 │ │                     │ │ LU2 │ │
      │ └─────┘ │─121b                │ └─────┘ │─121d
      │ │ LU1 │ │                     │ │ LU3 │ │
      └─────────┘                     └─────────┘
```

FIG. 4B

```
111a  11a                              111b        11b

  ┌─────────────────────┐      ┌─────────────────────┐
  │   CONTROLLER 0       │      │   CONTROLLER 1      │
  │                      │      │                     │
  │   ┌──────────┐       │      │   ┌──────────┐      │
  │   │  DATA    │       │      │   │  DATA    │      │
  │   │  CACHE   │       │      │   │  CACHE   │      │
  │   └──────────┘       │      │   └──────────┘      │
  │  ┌─────────────┐     │      │  ┌─────────────┐    │
  │  │CONFIGURATION│     │      │  │CONFIGURATION│    │
  │  │ MANAGEMENT  │     │      │  │ MANAGEMENT  │    │
  │  │   MEANS     │     │      │  │   MEANS     │    │
  │  └─────────────┘     │      │  └─────────────┘    │
  └─────────────────────┘      └─────────────────────┘
           112a                          112b

         ┌──────12a                      ┌──────12b
      ┌─────────┐                     ┌─────────┐
      │  DISK   │                     │  DISK   │
      │APPARATUS│                     │APPARATUS│
      │ ┌─────┐ │─121a                │ ┌─────┐ │─121c
      │ │ LU0 │ │                     │ │ LU2 │ │
      │ └─────┘ │                     │ └─────┘ │
      │ │ LU1 │ │─121b                │ │ LU3 │ │─121d
      └─────────┘                     └─────────┘
```
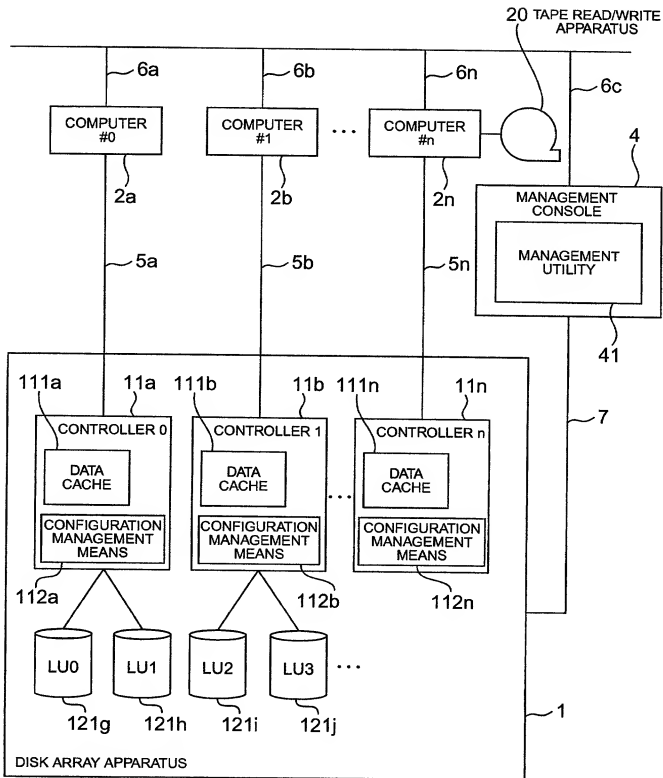
FIG. 5A

CONFIGURATION TABLE BEFORE TAKE-OVER

1121 ×

INTERNAL LUN	EXTERNAL LUN	PORT NUMBER	CONTROLLER NUMBER		BLOCK NUMBER	RAID GROUP NUMBER	RAID LEVEL	PHYSICAL ADDRESS INFORMATION
			DEFAULT	CURRENT				
0	1	0	0	0	⋮	⋮	⋮	⋮
1	3	0	0	0	⋮	⋮	⋮	⋮
2	0	1	0	0	⋮	⋮	⋮	⋮
3	2	1	0	0	⋮	⋮	⋮	⋮

FIG. 5B

CONFIGURATION TABLE AFTER TAKE-OVER

1121 ×

INTERNAL LUN	EXTERNAL LUN	PORT NUMBER	CONTROLLER NUMBER		BLOCK NUMBER	RAID GROUP NUMBER	RAID LEVEL	PHYSICAL ADDRESS INFORMATION
			DEFAULT	CURRENT				
0	1	0	0	0	⋮	⋮	⋮	⋮
1	3	0	0	0	⋮	⋮	⋮	⋮
2	0	0	1	1	⋮	⋮	⋮	⋮
3	2	0	1	1	⋮	⋮	⋮	⋮

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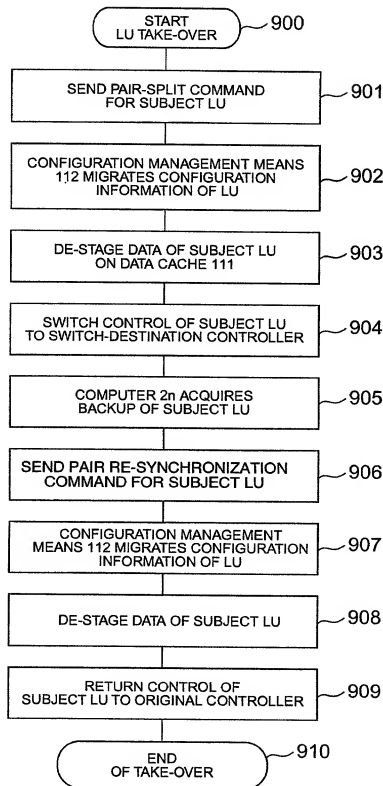
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Title: Disk Array System Capable for Taking Over Volumes Between...

Atty Docket No. 16869S-043800

Sheet 6 of 10

FIG. 6

20 TAPE READ/WRITE APPARATUS

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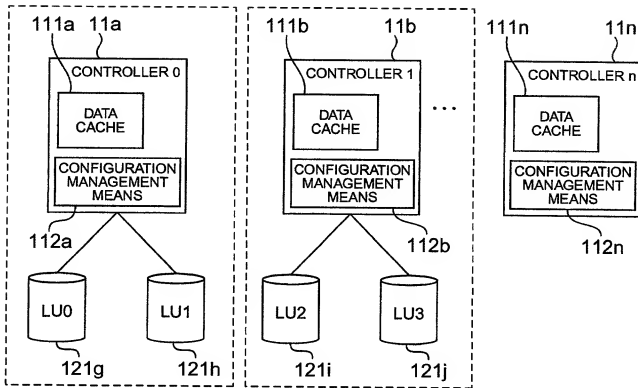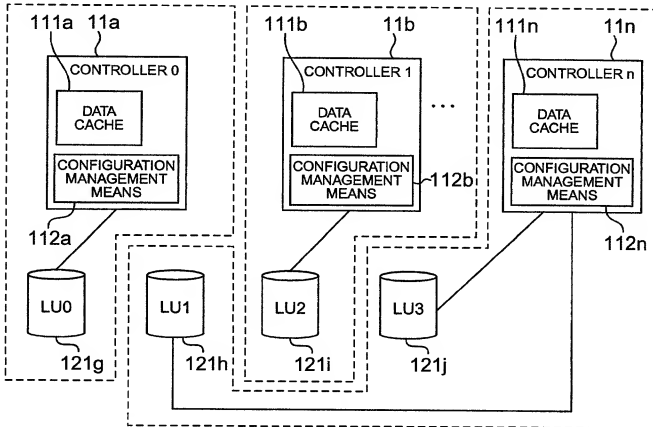
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Title: Disk Array System Capable for Taking Over Volumes Between...

Atty Docket No. 16869S-043800

Sheet 7 of 10

FIG. 7

```
        ┌──────────────────┐
        │      START       │ ~900
        │  LU TAKE-OVER    │
        └──────────────────┘
                │
   ┌─────────────────────────────┐
   │   SEND PAIR-SPLIT COMMAND   │ ~901
   │       FOR SUBJECT LU        │
   └─────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │ CONFIGURATION MANAGEMENT MEANS  │ ~902
   │   112 MIGRATES CONFIGURATION    │
   │       INFORMATION OF LU         │
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │  DE-STAGE DATA OF SUBJECT LU    │ ~903
   │      ON DATA CACHE 111          │
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │  SWITCH CONTROL OF SUBJECT LU   │ ~904
   │ TO SWITCH-DESTINATION CONTROLLER│
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │    COMPUTER 2n ACQUIRES         │ ~905
   │    BACKUP OF SUBJECT LU         │
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │ SEND PAIR RE-SYNCHRONIZATION    │ ~906
   │   COMMAND FOR SUBJECT LU        │
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │   CONFIGURATION MANAGEMENT      │ ~907
   │ MEANS 112 MIGRATES CONFIGURATION│
   │       INFORMATION OF LU         │
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │  DE-STAGE DATA OF SUBJECT LU    │ ~908
   └─────────────────────────────────┘
                │
   ┌─────────────────────────────────┐
   │     RETURN CONTROL OF           │ ~909
   │ SUBJECT LU TO ORIGINAL CONTROLLER│
   └─────────────────────────────────┘
                │
        ┌──────────────────┐
        │       END        │ ~910
        │   OF TAKE-OVER   │
        └──────────────────┘
```

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Title: Disk Array System Capable for Taking Over Volumes Between...

Atty Docket No. 16869S-043800

Sheet 8 of 10

FIG. 8A

111a 11a	111b 11b	111n 11n
CONTROLLER 0	CONTROLLER 1	CONTROLLER n
DATA CACHE	DATA CACHE ···	DATA CACHE
CONFIGURATION MANAGEMENT MEANS	CONFIGURATION MANAGEMENT MEANS	CONFIGURATION MANAGEMENT MEANS
112a	112b	112n
LU0 LU1	LU2 LU3	
121g 121h	121i 121j	

FIG. 8B

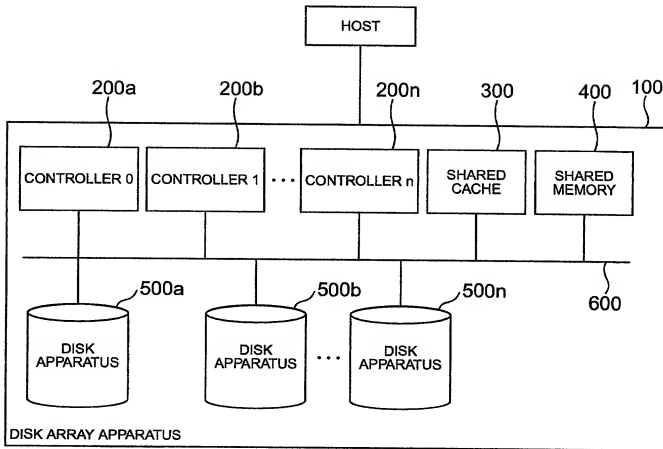| 111a 11a	111b 11b	111n 11n
CONTROLLER 0	CONTROLLER 1	CONTROLLER n
DATA CACHE	DATA CACHE ···	DATA CACHE
CONFIGURATION MANAGEMENT MEANS	CONFIGURATION MANAGEMENT MEANS —112b	CONFIGURATION MANAGEMENT MEANS
112a		112n
LU0 LU1	LU2 LU3	
121g 121h	121i 121j	

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Applicant: Yoichi Mizuno, *et al.*
Title: Disk Array System Capable for Taking Over Volumes Between...
Atty Docket No. 16869S-043800
Sheet 9 of 10

FIG. 9A

CONFIGURATION TABLE BEFORE TAKE-OVER   1121 ×

INTERNAL LUN	EXTERNAL LUN	PORT NUMBER	CONTROLLER NUMBER		BLOCK NUMBER	RAID GROUP NUMBER	RAID LEVEL	PHYSICAL ADDRESS INFORMATION
			DEFAULT	CURRENT				
0	0	0	0	0	⋮	⋮	⋮	⋮
1	1	0	N	0	⋮	⋮	⋮	⋮
2	1	0	1	1	⋮	⋮	⋮	⋮
3	2	0	N	1	⋮	⋮	⋮	⋮

FIG. 9B

CONFIGURATION TABLE AFTER TAKE-OVER   1121 ×

INTERNAL LUN	EXTERNAL LUN	PORT NUMBER	CONTROLLER NUMBER		BLOCK NUMBER	RAID GROUP NUMBER	RAID LEVEL	PHYSICAL ADDRESS INFORMATION
			DEFAULT	CURRENT				
0	0	0	0	0	⋮	⋮	⋮	⋮
1	1	0	0	N	⋮	⋮	⋮	⋮
2	1	0	1	1	⋮	⋮	⋮	⋮
3	2	0	1	N	⋮	⋮	⋮	⋮

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Atty Docket No. 16869S-043800

Sheet 10 of 10

FIG. 10
PRIOR ART